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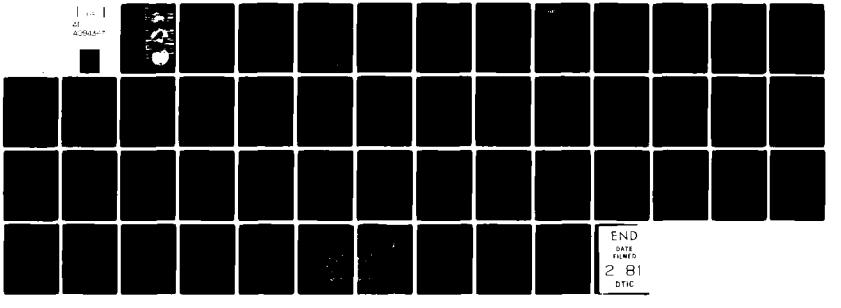

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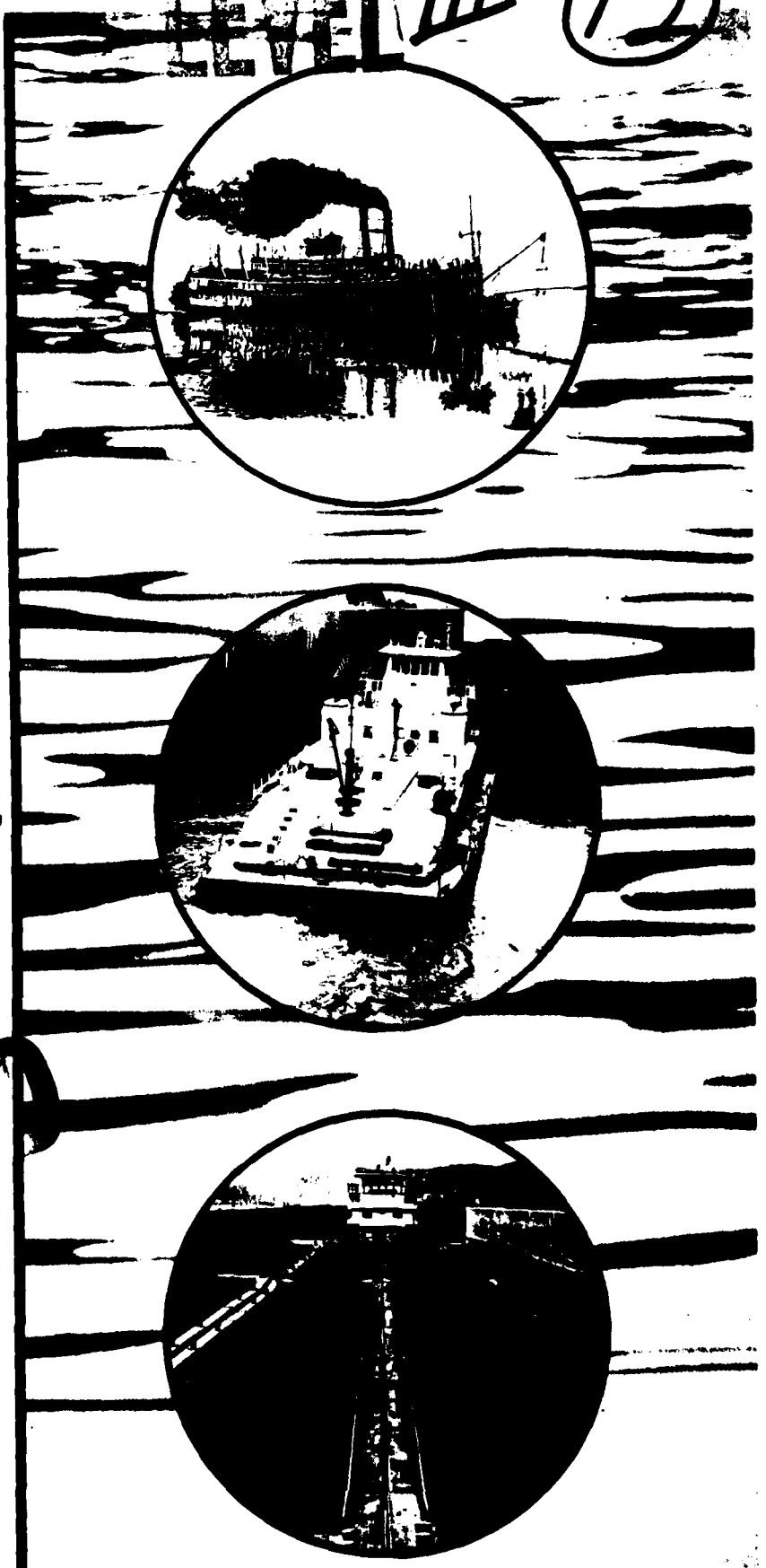
Projections Of Demand For Waterborne Transportation

Ohio River Basin 1980 - 2040

Volume 11

Feed and Food Products, Nec.



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Economic development	Ohio River Basin	Food
Economic forecasting	River basin development	Food products
Inland waterways	Traffic surveys	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This Corps of Engineers report describes one of three independent but complementary studies of future freight traffic on the Ohio River Basin Navigation System. Each of the studies considers existing waterborne commerce and develops a consistent set of projects of future traffic demands for all of the navigable waterways of the Basin. Each report contains information on past and present waterborne commerce in the Basin and projections by commodity groups and origin-destination areas from 1976 to at least 1990.

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(Continued from #20)
The three study projections, in conjunction with other analytical tools and system information, will be used to evaluate specific waterway improvements to meet short and long-term navigation needs. The output from these studies will serve as input to Corps' Inland Navigation Simulation Models to help analyze the performance and opportunities for improvement of the Ohio River Basin Navigation System. These data will be used in current studies relating to improvement of Gallipolis Locks, the Monongahela River, the Upper Ohio River, the Kanawha River, the Lower Ohio River, the Cumberland River and the Tennessee River, as well as other improvements.

This document is volume 11 of the 17 volume report shown below.

The study included a Commodity Resource Inventory, a Modal Split Analysis and a Market Demand Analysis. The work included investigation and analyses of the production, transportation and demand characteristics of each of the major commodities transported on the Ohio River and its tributaries. For each of 15 commodity groups, the demand for waterway transportation into, out of and within the Ohio River Basin was projected through the year 2040. A detailed study analysis and discussion for each commodity group is presented in 15 individually bound reports, supplemented by a methodology report. A study summary aggregates the commodity group totals for each of the several projections periods and lists the total waterborne commerce for each of the 72 operational locks and dams in the Ohio River Basin. The study results are presented in the following 17 documents:

Volume	Subject Title	
1	Study summary	
2	Methodology	
3	Group I:	Coal and coke
4	Group II:	Petroleum fuels
5	Group III:	Crude Petrol.
6	Group IV:	Aggregates
7	Group V:	Grains
8	Group VI:	Chemicals and chemical fertilizers
9	Group VII:	Ores and Minerals
10	Group VIII:	Iron ore, steel and iron
11	Group IX:	Feed and food products, nec.
12	Group X:	Wood and paper products
13	Group XI:	Petroleum products, nec.
14	Group XII:	Rubber, plastics, nonmetallic, mineral, products, nec.
15	Group XIII:	Nonferrous, metals and alloys, nec.
16	Group XIV:	Manufactured products, nec.
17	Group XV:	Other, nec.

Additionally, an Executive Summary is available as a separate document.

(9) Final rept.

Volume 11 of 17

GROUP IX,
FEED AND FOOD PRODUCTS, NEC.

(6)

PROJECTIONS OF DEMAND FOR WATERBORNE TRANSPORTATION, OHIO RIVER BASIN, 1980, 1990, 2000, 2020, 2040. Volume II.

Prepared for

U.S. ARMY CORPS OF ENGINEERS
OHIO RIVER DIVISION, HUNTINGTON DISTRICT

(15) Contract No. DACW69-78-C-0136

by

Robert R. Nathan Associates, Inc.
Consulting Economists
Washington, D.C.

(11) DECEMBER 1980

(12) 50

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"...one of three independent but complementary studies of future freight traffic on the Ohio River Basin Navigation System."

CONTENTS: v.1. Study summary.--v.2. Methodology.--v.3. Commodity groups .

1. Shipping--Ohio River Basin. 2. Inland water transportation--Ohio River Basin--Statistics. 3. Ohio River Basin. 1. United States. Army. Corps of Engineers. Ohio River Division. II. United States. Army. Corps of Engineers. Huntington District. III. Title.

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PREFACE

This Corps of Engineers report describes one of three independent but complementary studies of future freight traffic on the Ohio River basin navigation system. Each of the studies considers existing waterborne commerce and develops a consistent set of projections of future traffic demands for all of the navigable waterways of the basin. Each report contains information on past and present waterborne commerce in the basin with projections by commodity group and origin-destination areas from 1976 to either 1990 or 2040.

The three projections, in conjunction with other analytical tools and waterway system information, will be used to evaluate specific waterway improvements required to meet short and long-term navigation needs. The output from these studies will serve as input to Corps inland navigation simulation models to help analyze the performance and requirements for improvements of the Ohio River basin navigation system. These data will be used in current studies relating to improvements of Gallipolis Locks, the Monongahela River, the Upper Ohio River, the Kanawha River, the Lower Ohio River, and the Tennessee River, as well as for other improvements.

The reports on the three studies are referred to as the "CONSAD," the "BATTELLE," and the "NATHAN" reports. The latter and final report was completed in November 1980. It was prepared for the Corps of Engineers by Robert R. Nathan Associates, Inc., Consulting Economists, Washington D.C. This study encompasses the period 1976-2040, and is by far the most detailed of the three.

The "CONSAD" report, completed in January 1979, was prepared for the Corps by the CONSAD Research Corporation of Pittsburgh, Pennsylvania. The study and the 1976-1990 projected traffic demands discussed in that report were developed by correlating the historic waterborne commodity flows on the Ohio River navigation system, with various indicators of regional and national demands for the commodities. The demand variables which appeared to best describe the historic traffic pattern for each of the commodity groups was selected for projection purposes. The projected values for the demand variables are based upon the 1972 OBERS Series E Projections of National and Regional Economic Activity. The OBERS projections serve as national standards and were developed by the Bureau of Economic Analysis of the U.S. Department of Commerce, in conjunction with the Economic Research Service of the Department of Agriculture.

The "BATTELLE" report was completed in June 1979, and was prepared for the Corps by the Battelle Columbus Laboratories, Columbus, Ohio. The study and the 1976-1990 traffic projections discussed in that report were developed by surveying all waterway users in the Ohio River Basin through a combined mail survey and personal interview approach. The purpose of the survey was to obtain an estimate from each individual shipper of his future commodity

movements, by specific origins and destinations, as well as other associated traffic information. All identifiable waterway users were contacted and requested to provide the survey information. In addition, personal interviews were held with the major shippers. The responses were then aggregated to yield projected traffic demands for the Ohio River navigation system.

The "NATHAN" report presents the findings of a commodity resource inventory, a modal split analysis and a market demand analysis. The work included investigation and analyses of the production, transportation, and demand characteristics of each of the major commodities transported on the Ohio River and its tributaries. For each of 15 commodity groups, the demand for waterway transportation into, out of, and within the Ohio River basin was projected through the year 2040. A detailed study analysis and discussion for each commodity group is presented in 15 individually bound reports, supplemented by a methodology report. A Study Summary and an Executive Summary present appropriately abbreviated discussion and findings resulting from these analyses. The Study Summary aggregates the commodity group totals for each of the several projection periods and lists the total waterborne commerce for each of the 72 operational locks and dams in the Ohio River Basin.

The "NATHAN" report, "Projections of Demand for Waterborne Transportation, Ohio River Basin, 1980, 1990, 2000, 2020, 2040" consists of the following volumes:

Subject Title	Number of Pages	Volume Number
Study Summary	220	1
Methodology	118	2
Group I: Coal and Coke	134	3
Group II: Petroleum Fuels	66	4
Group III: Crude Petroleum	42	5
Group IV: Aggregates	64	6
Group V: Grains	131	7
Group VI: Chemicals and Chemical Fertilizers	90	8
Group VII: Ores and Minerals	61	9
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Group XV: Others, Nec.	48	17

Additionally, an Executive Summary is available as a separate document.

RRNA

PROJECTIONS OF DEMAND FOR WATERBORNE TRANSPORTATION OHIO RIVER BASIN 1980, 1990, 2000, 2020, 2040

Group IX: Feed and Food Products, Nec.

Prepared for
U.S. Army Corps of Engineers
Huntington District
Contract No. DACW69-78-C-0136

by
Robert R. Nathan Associates, Inc.
Consulting Economists
Washington, D.C.

November 1980

TABLE OF CONTENTS

I. INTRODUCTION

Group IX, food and feed products, nec., consists of prepared animal feeds and animal by-products, and a number of food products ranging from wheat flour to vegetable oils. During the 1969-76 period, these products accounted for not more than 0.6 percent of total Ohio River System (ORS) waterborne traffic. The bulk of waterborne food and feed product movements between 1969-74 was inbound. In 1975 and 1976, however, outbound exceeded inbound traffic.

The areas within the Ohio River Basin (ORB) for which projections of Group IX consumption, production and movements have been made are designated as Primary Study Areas (PSAs). The PSAs for Group IX are those U.S. Department of Commerce Bureau of Economic Analysis Areas (BEAs) and area segments (aggregations of counties within a BEA) which are origins or destinations of Group IX waterborne movements. A map showing Group IX PSAs is presented in the appendix to this report.

In addition to the PSAs, external areas linked to the ORB through waterborne commerce have been identified. Areas (BEAs) outside the ORB which are destinations of waterborne Group IX products, nec., movements originating in the ORB are designated as Secondary Consumption Areas (SCAs). Areas (BEAs) outside the ORB which are origins of Group IX waterborne movements destined to the ORB are designated as Secondary Production Areas (SPAs).

A. Description of Group IX

The individual products included in Group IX are:

Waterborne Commerce Statistics Code (WCSC)	Product/Commodity
2014	Tallow, animal and oils

2015	Animal by-products, not elsewhere classified (nec.)
2021	Dairy products, except dried milk and cream
2022	Dried milk and cream
2031	Fish and fish products including shellfish, prepared or preserved
2034	Vegetables and preparations, canned and otherwise prepared or preserved
2039	Fruits and fruit vegetable juices, canned and otherwise prepared or preserved
2041	Wheat flour and semolina
2042	Prepared animal feeds
2049	Grain mill products, nec.
2061	Sugar
2062	Molasses
2081	Alcoholic beverages
2091	Vegetable oils, all grades; margarines and shortening
2092	Animal oils and fats, nec., including marine
2094	Groceries
2095	Ice
2099	Miscellaneous food products.

Historical data indicate that only six products within Group IX may be expected to generate significant future waterborne traffic flows in the ORS. These products are:

- Wheat flour and semolina (WCSC 2041)
- Prepared animal feed (WCSC 2042)
- Grain mill products, nec. (WCSC 2049)
- Sugar (WCSC 2061)
- Molasses (WCSC 2062)
- Vegetable oils, all grades; margarines and shortening (WCSC 2091).

In the 1969-76 period, these six products accounted for between 95 and 99 percent of total food and feed product waterborne movements in the ORS. Some other food and feed products (WCSC 2014 and 2081) generated only small, and sometimes random, movements in the 1969-76 period. The remaining products (WCSC 2015, 2021, 2022, 2031, 2034, 2039, 2092, 2094 and 2099) recorded no waterborne movements at all during the base period, and it is not anticipated that any of them will move by water in the future.

B. Existing Waterway Traffic Flows

The total inbound, outbound and local Group IX waterborne traffic in the ORS was recorded at 447.4 thousand tons in 1969. This increased to a peak level of 1.3 million tons in 1976 (Table 1). In 1976, food and feed products accounted for only 0.6 percent of total ORS waterborne movements (Table 2).

B-1. BEA-to-BEA Traffic Flows

Between 1969 and 1976, waterborne shipments of Group IX products from one port equivalent (PE) to another in the Ohio River System (i.e., local traffic) decreased at a rate of 2.4 percent per annum. Inbound and outbound traffic, from or to points outside the ORS, experienced fluctuating but generally increasing trends. Outbound movements grew at the very rapid rate of 31.5 percent per annum. In both 1975 and 1976, outbound movements became the predominant waterborne flow of Group IX (Table 1).

BEAs 47 (Huntsville), 48 (Chattanooga) and 55 (Evansville) generated almost all of the outbound movements in 1976. The majority of the inbound movements were destined to BEAs 47 (Huntsville) and 62 (Cincinnati) (Table 3). The importance of these BEAs is not expected to change in the future as they are the locations of either major food and feed producers (i.e., soybeans processors in

Table 1. Ohio River System: Waterborne Shipments of Feed and Food Products, by Product Inbound, Outbound, and Local Movements, 1969-76

(Thousands of tons unless otherwise specified)

Product and type of movements	1969	1970	1971	1972	1973	1974	1975	1976	Average annual percentage change, 1969-76
Total	447.4	594.7	661.6	610.8	589.0	726.4	1,060.8	1,267.4	16.0
Inbound	289.3	351.4	378.8	380.6	338.0	405.9	458.4	458.7	6.8
Outbound	113.2	177.4	218.9	192.1	223.2	305.8	563.2	770.9	31.5
Local	44.9	65.9	63.9	38.1	27.8	14.7	39.3	37.8	(2.4)
Tallow	10.1	11.7	16.7	27.7	22.8	31.1	21.8	7.6	(4.0)
Inbound	--	--	--	--	--	2.7	--	--	--
Outbound	2.9	7.2	16.7	27.7	21.3	28.4	21.8	7.6	14.8
Local	7.2	4.5	--	--	1.5	--	--	--	--
Wheat flour and semolina	53.8	62.0	90.9	99.7	46.7	59.7	70.0	92.4	8.0
Inbound	15.1	17.1	43.7	90.0	46.7	58.8	62.7	81.3	27.2
Outbound	0.9	1.8	1.8	--	--	0.9	0.9	--	--
Local	37.8	43.1	45.4	9.7	--	--	6.4	11.1	(16.1)
Prepared animal feeds	64.6	53.2	72.9	64.6	41.8	34.0	6.4	88.0	4.5
Inbound	64.6	53.2	72.9	57.5	41.8	34.0	--	52.3	(3.0)
Outbound	--	--	--	7.1	--	--	6.4	35.7	a
Local	--	--	--	--	--	--	--	--	--
Grain mill products	139.0	208.8	215.6	191.3	280.1	390.5	741.2	751.4	27.3
Inbound	40.3	108.3	100.1	48.7	95.2	129.8	240.6	132.1	18.5
Outbound	98.7	99.1	113.4	141.8	183.8	259.9	490.5	618.2	30.0
Local	--	1.4	2.1	0.8	1.1	0.8	10.1	1.1	a
Sugar	55.4	37.3	30.9	36.2	32.0	28.0	24.9	49.4	(1.6)
Inbound	55.2	37.3	30.9	36.2	32.0	28.0	24.9	49.4	(1.6)
Outbound	0.2	--	--	--	--	--	--	--	--
Local	--	--	--	--	--	--	--	--	--
Molasses	81.0	103.6	97.0	87.8	87.8	104.6	80.5	53.4	(5.8)
Inbound	81.0	100.9	94.5	87.8	74.0	95.2	74.9	48.9	(7.0)
Outbound	--	1.4	2.5	--	13.8	9.4	5.6	4.5	a
Local	--	1.3	--	--	--	--	--	--	--

(Continued)

Table 1. (Continued)

Product and type of movements	1969	1970	1971	1972	1973	1974	1975	1976	Average annual percentage change, 1969-76
Alcohols	--	--	2.9	2.8	--	2.7	2.5	4.5	a
Inbound	--	--	2.9	2.8	--	2.7	2.5	4.5	a
Outbound	--	--	--	--	--	--	--	--	--
Local	--	--	--	--	--	--	--	--	--
Vegetable oils	43.5	118.2	134.7	100.7	78.0	75.8	113.5	220.4	26.1
Inbound	33.1	34.7	33.8	57.6	48.3	54.7	52.7	89.9	15.3
Outbound	10.4	67.9	84.5	15.5	4.4	7.2	38.1	105.0	39.1
Local	--	15.6	16.4	27.6	25.3	13.9	22.7	25.5	a

a. No tonnage reported in 1969.

Note: Individual items may not add to totals due to rounding. No waterborne movements were reported for waterborne commodity code no. 2015 (animal by-products); 2021 (dairy products); 2022 (dried milk and cream); 2031 (fish and fish products); 2034 (vegetables and preparations); 2039 (fruits and fruit vegetable juices); 2092 (animal oils and fats); 2094 (groceries); 2095 (ice); and 2099 (miscellaneous food products).

Source: Waterborne Commerce by Port Equivalents, 1969-76, supplied by the U.S. Army Corps of Engineers.

Table 2. Ohio River System: Waterborne Shipments of All Commodities and of Food and Feed Products, 1976

(Thousands of tons unless otherwise specified)

	Total	Inbound	Outbound	Local
All commodities	200,770.5	29,439.5	26,854.0	144,477.0
Food and feed products	1,267.4	485.7	770.9	37.8
As a percentage of all commodities	0.6	1.6	2.9	0.03

Source: Compiled by RRNA from Waterborne Commerce by Port Equivalents, revised 1976, supplied by U.S. Army Corps of Engineers.

Table 3. Ohio River Basin: Waterborne Commerce by BEA, 1976
Group IX: Feed and Food Products, Nec.
(Thousands of tons)

Origin	Destination														
	Total	ORB BEAs	BEA 47	BEA 48	BEA 49	BEA 50	BEA 54	BEA 55	BEA 62	BEA 66	Non-ORB BEAs	BEA 46	BEA 79	BEA 138	BEA 141
Total	1,267.4	496.5	156.3	29.3	15.6	6.7	15.7	22.3	197.1	53.5	770.9	14.5	1.1	750.8	4.5
ORB BEAs	808.7	37.8	1.1	--	--	--	2.2	--	34.5	--	770.9	14.5	1.1	750.8	4.5
BEA 47	313.0	3.3	1.1	--	--	--	2.2	--	--	--	309.7	14.5	1.1	294.1	--
BEA 48	145.8	--	--	--	--	--	--	--	--	--	145.8	--	--	145.8	--
BEA 49	4.5	--	--	--	--	--	--	--	--	--	4.5	--	--	--	4.5
BEA 55	257.7	34.5	--	--	--	--	--	--	34.5	--	223.2	--	--	223.2	--
BEA 62	83.2	--	--	--	--	--	--	--	--	--	83.2	--	--	83.2	--
BEA 66	4.5	--	--	--	--	--	--	--	--	--	4.5	--	--	4.5	--
Non-ORB BEAs	458.7	458.7	155.2	29.3	15.6	6.7	13.5	22.3	162.6	53.5					
BEA 77	20.7	20.7	16.6	4.1	--	--	--	--	--	--					
BEA 78	1.1	1.1	--	1.1	--	--	--	--	--	--					
BEA 79	8.5	8.5	--	--	--	--	--	4.5	4.0	--					
BEA 91	28.9	28.9	15.6	7.3	--	--	--	--	6.0	--					
BEA 103	43.4	43.4	43.4	--	--	--	--	--	--	--					
BEA 108	13.4	13.4	13.4	--	--	--	--	--	--	--					
BEA 111	12.3	12.3	--	--	--	--	--	1.1	6.7	4.5					
BEA 113	27.2	27.2	--	--	--	--	--	--	27.2	--					
BEA 114	88.1	88.1	--	--	--	--	--	--	46.9	41.2					
BEA 133	1.1	1.1	--	1.1	--	--	--	--	--	--					
BEA 137	2.0	2.0	2.0	--	--	--	--	--	--	--					
BEA 138	212.0	212.0	64.2	15.7	15.6	6.7	13.5	16.7	71.8	7.8					

Traffic external to Ohio River System

Source: U.S. Army Corps of Engineers, Waterborne Commerce by Port Equivalents, revised 1976.

BEAs 47 and 55) or major food processors (e.g., Proctor and Gambel in BEA 62).

B-2. Highlights of Important Links

Major waterway shippers of Group IX products in the areas served by the ORS in 1976 were BEAs 47 (Huntsville), 48 (Chattanooga) and 55 (Evansville). Major receivers in the area were BEAs 47 and 62 (Cincinnati). BEA 138 (New Orleans) was both the most important external source of food and feed products destined to the area served by the ORS and the most important external destination of Group IX shipments from the area.

a. Local Movements

Between 1969 and 1971, wheat flour and semolina constituted the majority of local movements. Between 1972 and 1976, vegetable oils constituted the majority of local waterborne movements of Group IX. Most of these two food and feed products originated from grain processors in BEA 55 (Evansville) and were destined to one food processor in BEA 62 (Cincinnati). Local movements of other food and feed products were random and relatively small.

Local waterborne movements of food and feed products were insignificant compared to total Group IX waterborne movements. They accounted for between 3 and 11 percent of the Group's total ORS movements in the 1969-76 period (Table 1).

b. Inbound Movements

Inbound waterborne movements of food and feed products to the PSAs during the 1969-76 period increased at an average rate of 6.8 percent per annum, from 289.3 thousand tons to 458.7 thousand tons. However, over that period, inbound movements did lose some importance relative to total Group IX waterborne movements.

Between 1969 and 1976, four rivers of the ORS were recipients of Group IX shipments: the Allegheny, Cumberland, Ohio, and Tennessee. Of these four, the Ohio and the Tennessee were the most important (Table 4). In 1976, the Ohio River was the destination for 49 percent of Group IX's waterborne receipts (242.9 thousand of 496.5 thousand tons). Of Ohio River receipts, 82 percent originated on the lower and upper Mississippi River. More than 81 percent of Ohio River receipts was destined for the Cincinnati area.

Table 4. Ohio River System: Waterborne Receipts of Food and Feed Products, by River of Origin and River of Destination, 1976

(Thousands of tons)

River of origin	Total receipts	River of destination			
		Ohio River	Tennessee River	Cumberland River	Allegheny River
Total	496.5	242.9	192.3	15.6	45.7
Ohio River System	37.8	36.7	1.1	--	--
Ohio River	34.5	34.5	--	--	--
Tennessee River	3.3	2.2	1.1	--	--
Outside Ohio River System	458.7	206.2	191.2	15.6	45.7
Great Lakes	10.1	--	10.1	--	--
Gulf Intercoastal Waterway	2.0	--	2.0	--	--
Illinois Waterway	11.7	--	11.7	--	--
Lower Mississippi River	213.1	109.8	87.7	15.6	--
Upper Mississippi River	152.7	88.6	22.9	--	41.2
Missouri River	69.1	7.8	56.8	--	4.5

Source: U.S. Army Corps of Engineers, Waterborne Commerce by Port Equivalents, revised 1976.

In 1976, the Tennessee River was the destination for 42 percent of Group IX's inbound movements (191.2 thousand of 458.7 thousand tons). Of Tennessee River receipts, 46 percent originated on the lower Mississippi and 30 percent originated on the Missouri River. Guntersville Pool received more than 67 percent of the total traffic destined to the Tennessee River.

c. Outbound Movements

Between 1969 and 1976, outbound movements of food and feed products in the ORS increased at an average rate of 31.5 percent per annum, from 113.2 thousand tons to 770.9 thousand tons. The volume of outbound movements surpassed inbound movements in 1975 and 1976.

Three rivers of the ORS were shippers of food and feed products: the Allegheny, the Ohio, and the Tennessee. Of these three, the Tennessee River accounted for almost 60 percent of Group IX shipments originating in the ORS in 1976; the Ohio River, about 40 percent; and the Allegheny River, less than 1 percent (Table 5). Almost 100 percent of outbound Group IX movements from the ORS were destined for the lower Mississippi River that year. Eighty percent of these Group IX shipments to the lower Mississippi was grain mill products (mostly soybean meal), and almost 12 percent was vegetable oil (mostly soybean oil). These two products accounted for well over 90 percent of outbound Group IX movements between 1969-76.

d. Intermodal Transfers

There are few rail-to-barge intermodal transfers of Group IX products in the area served by the ORS. Occasionally a food product such as wheat flour is trucked a short distance from rail or barge site to food processor. However, the product is generally shipped from the producer to the consumer via a single modal link.

C. Summary of Study Findings

The consumption of food and feed products in the PSAs decreased approximately 5 percent from 5.1 million tons in 1969 to somewhat less than 4.9 million tons in 1976. Production is projected to increase 2.7 percent annually through 2000. Therefore, the margin between production and consumption is expected to narrow substantially. By 2040, the production of food and feed products in the PSAs is expected to be 10.0 million tons, while consumption will be approximately 10.9 million tons.

Table 5. Ohio River System: Waterborne Shipments of Food and Feed Products, by River of Destination and River of Origin, 1976

(Thousands of tons)

River of destination	Total shipments	River of origin		
		Ohio River	Tennessee River	Allegheny River
Total	808.7	340.9	363.3	4.5
Ohio River System	37.8	34.5	3.3	--
Ohio River	36.7	34.5	2.2	--
Tennessee River	1.1	--	1.1	--
Outside Ohio River System	770.9	306.4	460.0	4.5
Lower Mississippi River	760.8	306.4	454.4	--
Upper Mississippi River	5.6	--	1.1	4.5
Houston Ship Channel	4.5	--	4.5	--

Source: U.S. Army Corps of Engineers, Waterborne Commerce by Port Equivalents, revised 1976.

BEAs 47 (Huntsville) and 48 (Chattanooga) are expected to remain major production areas. Food and feed product consumption is expected to remain relatively evenly distributed throughout the area served by the ORS.

Net waterborne movements in the ORS are expected to increase 76 percent between 1976 and 1980, from 312.2 thousand tons to over 550.1 thousand tons. In the 1976-2000 period, inbound, outbound and local waterborne movements of food and feed products are expected to grow at average annual rates of 0.7 percent. 2.7 percent and 2.5 percent, respectively. Gross waterborne movements are projected to grow 2.0 percent per year. They will reach 2.1 million tons in 2000. During the period 2000-2040, waterborne movements are expected to continue to increase but at less than 2.0 percent annually.

II. MARKET DEMAND ANALYSIS

Between 1969 and 1976, consumption of food and feed products in the PSAs decreased at a slight rate of 0.58 percent per annum. In 1969, 5.1 million tons of food and feed products were consumed by livestock and food processors located in the PSAs. By 1976, this had decreased to 4.9 million tons. In the future, as both livestock production and population increase, consumption of Group IX products in the PSAs is also expected to increase.

A. Market Areas

In addition to local demand for Group IX commodities produced in the PSAs, demand also is generated by Secondary Consumption Areas (SCAs) located outside the ORB. These SCAs are defined as BEAs which are the destinations of waterborne Group IX movements originating in the Ohio River Basin.

A-1. Primary Study Areas (PSAs)

This study has identified eight BEAs and BEA segments in the ORB which either have been or will be the ultimate origins or destinations of waterborne food and feed product movements. Appendix Table A-1 presents the BEAs and BEA segments which constitute the PSAs for food and feed products, and for which food and feed product consumption has been analyzed and projected.

A-2. Secondary Consumption Areas (SCAs)

BEAs outside the Ohio River Basin which are destinations of waterborne shipments from the ORS were not segmented. In 1976, New Orleans (BEA 138) received 750.8 thousand tons of food and feed products destined for export, consisting mainly of soybean meal and oil. This was more than 97 percent of Group IX shipments outbound

from the ORS. Between 1969 and 1976, BEA 138 was the most important SCA and the BEA expected to remain the most important SCA for Group IX in the future.

B. Product Uses

The uses of food and feed products vary widely among individual products. Grain mill products, such as soybean meal, are used almost exclusively as animal feed. Most of the wheat produced and consumed domestically is ground for edible flour.

There are seven classes of wheat: hard red spring wheat; durum wheat; red durum wheat; hard red winter wheat; soft red winter wheat; white winter wheat; and mixed wheat. Mixtures of wheats to obtain specific flour characteristics are common. The soft wheats produce flour used in baked goods such as pies, pastry, and cakes. The hard wheats are used in the making of rolls and breads. Durum wheats are used for macaroni and in mixtures.

As wheat varies according to class, climate, and soil, uniformity in flour formerly was obtained by blending wheats from different areas to obtain an average mix. It is now obtained by an air-spinning process which separates the milled flour into fractions according to protein-starch ratios. It then combines the flour into a uniform ratio. These are called turbo-flours. Pregelatinized flour, which reduces the time needed for dextrinizing, is used for canned goods. Hydroxyethylated flour, made by treating wheat flour with ethylene oxide, is the wheatpaste used for textile coatings.

Vegetable oils are used mainly in the production of shortening, margarines, and cooking and salad oils. Non-food uses, including use in paints, varnishes, core oils, soaps, and lubricants, account for less than 10 percent of consumption. Oils are also used in rubber compounding, as vulcanizing agents, and as plasticizers.

Tallow is the general name for heavy fats obtained from the bodies of sheep and cattle. The best grades of internal fats, suet, are used for edible products. External fats are used in lubricants, soaps and candles. They are also used when mixing waxes and vegetable fats, and when producing chemicals. Beef tallow is used to produce stearic acid for leather dressing and soap-making, and in lubricating greases. Tallow for industrial use is generally purified and chemically treated.

Sugar, which can be derived from sugar cane or sugar beets, is most valued as a sweetening agent and a food preservative. The sucrose molecule is versatile and easy to grow. Therefore, sugar is one of the most valuable chemical raw materials. Sucrose benzoate is a benzoic acid derivative of sucrose which is used as a plasticizer and modifier for the synthetic resins used in lacquers and inks. Sucrose acetate butyrate, also used as a plasticizer in synthetic resins, improves extrusion and makes coatings flexible and adhesive. Sucrose esters are used as food additives.

Molasses is the heavy syrup left as a result of sugar crystallization. Edible molasses is a light, purified residual syrup. Blackstrap molasses, the final, heavy, unpurified and inedible syrup is used in the production of ethyl alcohol. In addition to human consumptive and industrial uses, molasses is fed to beef and dairy cows. Feeding molasses is an important carbohydrate and a source of certain trace elements and minerals, such as potassium, phosphorus, and magnesium, which are essential for bone formation and maintenance, milk production, fertility, and animal metabolism as a whole.

C. Consumption Characteristics

Consumption characteristics of food and feed products are determined by the factors which influence product demand. Among these are product prices, population growth and concentration, changes in disposable income, availability and suitability of substitutable goods, and changes in consumer patterns resulting from changes in taste.

C-1. Livestock Consumption Characteristics

The Group IX products which are consumed by livestock (i.e., corn and wheat mill feed, soybean meal, molasses, and prepared animal feed) are sources of carbohydrates, fats, minerals, vitamins, and protein. All five of these elements are vital to the profitable production of healthy livestock. A well-balanced livestock ration is one which contains these nutrients in proper ratio. It must be formulated to contain a balance of energy-producing elements, protein, fiber and mineral matter to prevent possible economic losses which might be incurred by a failure to feed livestock adequately.

This balance can be achieved through the feeding of different grains, in various ratios. Grains which provide the necessary

protein levels and energy contents can be substituted for one another. The degree to which they are substitutable is a function of price, relative to feed value. A relatively more expensive grain with a high feed value, for instance, may be chosen over a less expensive grain with a lower feed value.

Livestock prices are derived from the prices that consumers are willing to pay for meat. Meat prices are a function of consumer incomes, tastes, preferences, and expectations about future prices, as well as prices of competing goods. Farmers choose to produce larger numbers of animals, and to feed production rather than maintainence ratios, when livestock and grain prices assure acceptable profit levels. Livestock prices thus determine, or at least influence, the number of animals that livestock farmers are willing and able to produce. The larger the number of animals, the more feed that will be used.

A major factor contributing to increases in consumption of food and feed products is severe weather. Unusual cold weather stress causes weight loss to feedlot cattle and hogs forcing higher feed costs per animal. Disease, on the other hand, can lower livestock production and, therefore, Group IX consumption.

Government regulations also affect food and feed product consumption by encouraging or discouraging livestock production. For instance, the uncertainty of possible carcinogenic properties in nitrates is of great concern to livestock producers in making production decisions since nitrates are used by more than 60 percent of domestic pork producers as anti-botulism elements in the curing and preserving of meat. Freezing, the major alternative to nitrate use in the prevention of botulism, may not prove to be an adequate substitute. Changes in characteristic color, taste and textures of meat as a result of freezing can cause consumer resistance.

C-2. Industry Consumption Characteristics

Industry consumption of food and feed products (i.e., sugar, wheat flour, and vegetable oils) is influenced by final product demand which, in turn, is influenced by many other factors.

Sugar is contained in the final products of processed fruits, baking products, candies, and bottled and canned soft drinks. Wheat flour and vegetable oils are contained in baking products, margarines, shortenings, and salad and cooking oils. Consumer

taste and disposable income, as well as product prices, determine the demand for food and feed products as embodied in these examples of prepared foods. For instance, growth in the consumption of fast foods, frozen packaged entrees and soft drinks has resulted in growth in the demand for an consumption of food and feed products.

Specifically, Americans are rapidly increasing their sugar consumption via soft drinks. United States per capita soft drink consumption has increased by more than 48 percent since 1970, and the latest available data reveal that each American consumed 359 twelve-ounce containers of bottled and canned soft drinks during 1977. This was nearly 34 gallons per person.[1]

Wheat flour is generally consumed in the form of bakery products. According to a Bureau of Labor Statistics survey,[2] family size and average income affect consumer expenditures on bakery products. For example, increasing the average family size by one member would result in an additional average weekly expenditure for all bakery products of as much as 71 cents. Higher average family incomes for various income groups are also associated with greater average family expenditures for bakery products. An exception is in expenditures for bread. Increases in the demand for wheat flour are additionally influenced by population growth.

Soybean oil is presently the largest single source of vegetable fats and oils. It exceeded cottonseed as the principal oil source in the manufacture of both margarines and shortenings in 1950. Per capita consumption of vegetable oils increased 25 percent between 1969 and 1976, from 39.2 pounds to 49 pounds. To some extent in processed foods, soybean oil can be substituted for other vegetable oils, such as palm and coconut, without altering product tastes.

Increased ingredient and operating (energy) costs, and greater regulatory involvement can affect food and feed product consumption by food processors both directly and indirectly. Higher overall production costs lead to ingredient substitution (i.e., corn syrup for sugar, cottonseed oil for soybean). Higher processed food

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1. U.S. Department of Commerce, Industry and Trade Administration, U.S. Industrial Outlook, 1979 ed. (Washington, D.C.: GPO, 1979).
2. Ibid.

costs, such as those resulting from higher sugar costs and content labeling regulations, lead to a decline in per capita consumption of processed foods and, therefore, to a decline of Group IX product consumption. Intensified consumer and government concern over the nutrient content of sugar could have an impact on sugar consumption in the soft drink and snack food industries. Several public interest groups have petitioned the Federal Trade Commission to ban advertising of highly-sugared products during childrens' television shows, and the U.S. Department of Agriculture is considering prohibiting schools from selling candy and other foods with high sugar content during school hours.

Thus, consumer concerns over the nutrient content of processed foods in general could have a dramatic impact on the food and kindred products industry and on Group IX product consumption. Food processors will continue to develop new products as well as use a greater number of "natural" ingredients in response to consumer concern over potentially harmful additives.

D. Existing Aggregate Demands

The demand for food and feed products in the PSAs declined slightly between 1969 and 1976. It varied from a low of 4.77 million tons in 1975 to a high of 5.26 million tons in 1970. Overall, decline was at a rate of 0.58 percent per annum (Table 6).

BEA 49 (Nashville) was the largest PSA consumer of food and feed products (Table 6). During the base period, declining consumption of Group IX products by livestock was compensated for by greater increases in industrial consumption. Of the 4.86 million tons of food and feed products consumed in the PSAs in 1976, 3.35 million tons, or approximately 70 percent, were consumed by industry in the production of a variety of food and kindred products and nonfood items. Livestock consumption of Group IX products (prepared animal feed and grain mill products) accounted for 1.52 million tons, or approximately 30 percent of total consumption. Over time, this ratio has varied somewhat in favor of industrial consumption, as livestock consumption has generally declined.

E. Forecasting Procedures and Assumptions

The projections of the consumption of food and feed products by industrial users were based on existing projections. The primary projections were provided by the U.S. Water Resources Council

Table 6. Ohio River Basin: Consumption of Food and Feed Products, by BEAs or BEA Segments,[a] Estimated 1969-76

(Thousands of tons unless otherwise specified)

BEA and BEA segment	1969	1970	1971	1972	1973	1974	1975	1976	Average annual percentage change 1969-76
Primary Study Areas	5,068.3	5,261.8	5,038.7	4,999.9	5,025.6	4,972.8	4,769.1	4,864.3	(0.58)
BEA 47: Huntsville, AL	439.4	464.4	454.6	461.8	457.6	474.1	446.8	447.8	0.27
BEA 48: Chattanooga, TN	485.9	500.9	493.6	504.4	512.4	507.4	495.5	505.3	0.56
BEA 49: Nashville, TN	970.0	1,020.0	970.3	962.7	992.5	966.3	960.6	953.2	(0.25)
BEA 50: Knoxville, TN	317.7	325.7	318.5	332.3	342.5	344.2	345.7	350.5	1.41
BEA 54: Louisville, KY	783.8	818.5	767.9	755.3	750.8	763.3	714.2	730.5	(1.00)
BEA 55: Evansville, IN	745.5	797.8	742.0	721.9	707.2	695.3	649.6	667.7	(1.56)
BEA 62: Cincinnati, OH	802.4	807.2	781.1	761.8	769.7	735.0	704.7	741.8	(1.12)
BEA 66: Pittsburgh, PA	532.6	527.0	510.7	499.8	492.9	487.2	452.1	467.5	(1.61)

Note: Food and feed products consumed by livestock (i.e. prepared animal feed and grain mill products, nec.) were derived by multiplying the BEA segment level corn consumption in tons by all livestock categories by a factor of .234 tons. This factor represents the amount of prepared animal products and grain mill products, nec. consumed per ton of corn consumed. The resulting livestock food and feed products consumption was then multiplied by 1.3 to add an additional 30 percent to the consumption weight represented by additional commodities (fish protein, phosphates, dried milk, etc.) added in the preparation of prepared animal feeds. State totals of receipts for 1972 of food and feed products consumed as intermediate industrial goods (i.e. wheat flour, sugar, soybean oil and corn oil) were estimated from national and regional receipts of these commodities as derived from the 1972 Census of Transportation. State totals were distributed among BEA segments based on the distribution of 1972 and 1973 employment in the food and kindred products industry by state and county. Industrial consumption for 1969 to 1976 was derived by using the annual change in employment in the food and kindred products industry by state, applied to the appropriate portion of the BEA or BEA segment.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Corn consumption by livestock by BEA segment from Grains (Group V) Report adjusted for variances in Commodity Group V and IX hinterlands. Prepared animal feed and grain mill products, nec. relationship to livestock corn consumption and percentage of other commodities added to food and feed products to produce prepared animal feed from U.S. Department of Agriculture, Agricultural Statistics, 1977. Industrial consumption from U.S. Department of Commerce, Bureau of the Census, 1972 Census of Transportation and County Business Patterns, 1972, 1973 eds.

(OBERS, Series E). The 1974-76 three-year average estimates for industrial consumption of food and feed products (i.e., wheat flour, sugar, corn and soybean oil) were projected to 1980-2040 using the growth rate of earnings in the food and kindred products industry. The projected growth rates for the consumption of food and feed products in each BEA segment are assumed to be the same as those of the BEA as a whole.

Projections for the consumption of food and feed products by livestock (prepared animal feed, grain mill products, and molasses) were based on projections of corn consumption by livestock and by PSA, provided by the Grains (Group V) Report. A factor of .234 tons, which represents the average amount of prepared animal feed and grain mill products consumed by livestock per ton of corn consumed between 1969 and 1976, was applied to projected corn consumption in the future. This projection provided estimates of overall livestock consumption of Group IX products.

The assumption that underlies this procedure is that the relationship between livestock consumption of Group IX products and corn consumption will remain the same. The assumptions that underly the projection of corn consumption by livestock, as outlined in the Grain (Group V) Report, also apply.

F. Probable Future Demand

Food and feed product consumption in the PSAs is expected to grow in the coming decades. In each BEA, or BEA segment, growth is expected to occur in both livestock and industrial consumption. The importance of industrial consumption to total Group IX consumption is expected to increase to more than 80 percent of the total in 2040. This compares to its present 70 percent.

A gradual but steady increase in total food and feed product consumption in the PSAs is expected, amounting to 1.55 percent per annum between 1976 and 2000, and 1.06 percent per annum between 2000 and 2040 (Table 7). Group IX consumption in the PSAs is expected to be 5.2 million tons in 1980, 7.2 million tons by 2000, and 10.9 million tons by 2040.

BEA, or BEA segment, consumption is expected to remain relatively evenly distributed throughout the area served by the ORS. However, BEA 49 (Nashville) is expected to remain the largest PSA consumer.

Table 7. Ohio River Basin: Consumption of Food and Feed Products, by BEAs or BEA Segments,[a] Estimated Average 1974-76 and Projected 1980-2040, Selected Years

(Thousands of tons unless otherwise specified)

BEA and BEA segment	Estimated average 1974-76	Projected					Average annual percentage change	
		1980	1990	2000	2020	2040	1974-76—2000	2000-2040
Primary Study Areas	4,868.8	5,218.0	6,075.6	7,155.5	9,420.7	10,930.6	1.55	1.06
BEA 47: Huntsville, AL	456.2	492.2	607.3	737.3	1,024.1	1,225.0	1.94	1.28
BEA 48: Chattanooga, TN	502.8	558.9	675.6	796.5	1,053.9	1,220.8	1.86	1.07
BEA 49: Nashville, TN	960.0	1,052.2	1,251.3	1,497.1	1,968.5	2,289.9	1.79	1.07
BEA 50: Knoxville, TN	346.8	385.8	463.9	556.6	775.0	919.6	1.91	1.26
BEA 54: Louisville, KY	736.0	801.8	909.7	1,057.2	1,381.7	1,595.9	1.46	1.03
BEA 55: Evansville, IN	670.9	614.4	680.1	784.3	947.9	1,062.3	0.63	0.76
BEA 62: Cincinnati, OH	727.2	807.2	932.8	1,101.4	1,474.7	1,719.1	1.67	1.12
BEA 66: Pittsburgh, PA	468.9	505.5	555.0	625.2	794.9	898.1	1.16	0.91

Note: Individual items may not add to total due to rounding. The 1974-76 three year average of estimated industrial consumption of food and feed products (i.e., wheat flour, sugar and corn and soybean oil) was projected for 1980-2040 using the growth rate of earnings in the food and kindred products industry as projected by U.S. Department of Commerce, OBERS Projections. The 1974-76 three year average of estimated livestock consumption of food and feed products (i.e., prepared animal feed and grain mill products, nec.) was projected for 1980-2040 using the growth rate of corn consumption by livestock by BEA and BEA segment projected for Grains (Group V) Report. Projected livestock corn consumption in tons by BEA and BEA segment was multiplied by a factor of .234 tons which represents the amount of prepared animal feed and grain products, nec. consumed per ton of corn consumed.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Consumption of food and feed products by BEA and BEA segment for 1974-76 from Table 6. Average annual growth rates for industrial consumption were derived from U.S. Water Resources Council, OBERS Projection, Regional Economic Activity in the U.S., Series E, 1972 ed., Vol. II.

III. COMMODITY RESOURCES INVENTORY

Production of food and feed products in the PSAs increased slightly between 1969 and 1976, at an average rate of 0.72 percent per annum. In 1969, somewhat less than 3.1 million tons of food and feed products were produced in the PSAs. By 1976, Group IX production had increased to more than 3.2 million tons. In the future, food and feed production in the PSAs is expected to increase as a greater percentage of existing capacity is utilized and as processing expansions occur.

A. Production Areas

The production of Group IX commodities in the PSAs is supplemented by production in Secondary Production Areas (SPAs) located outside the Ohio River Basin. These SPAs are defined as BEAs which are the origins of Group IX waterborne movements destined to the Ohio River Basin.

A-1. Primary Study Areas (PSAs)

This study has identified eight BEAs and BEA segments in the ORB which either have been or will be the ultimate origins or destinations of waterborne food and feed product movements. Appendix Table A-1 presents the BEAs and BEA segments which constitute the PSAs for food and feed products, and for which food and feed production has been analyzed and projected.

A-2. Secondary Production Areas (SPAs)

BEAs outside the Ohio River Basin which are origins of waterborne shipments of Group IX products to the ORB were not segmented. In 1976, New Orleans (BEA 138) shipped 211.9 thousand tons of food and feed products to the ORB, predominantly to BEAs 47 (Huntsville)

and 62 (Cincinnati). This was over 46 percent of the volume of Group IX shipments inbound to the ORB. Between 1969 and 1976, BEA 138 was the most important SPA shipping Group IX products to the ORB -- mainly molasses, sugar, and vegetable oil. Somewhat less important, but still significant, as Group IX SPAs are BEAs 114 (St. Louis), 103 (Sioux City), 91 (Minneapolis), 113 (Quincy) and 77 (Chicago). These BEAs mainly supply wheat flour, vegetable oils, and grain mill products to the PSAs.

Since most of the molasses and sugar consumed in the ORS hinterland has been and will be shipped to the area from BEA 138, this BEA is expected to remain the most significant SPA for Group IX waterborne shipments to the PSAs.

B. Production Characteristics

The production characteristics of food and feed products are determined by factors affecting the production of individual products. These include the availability of primary agricultural inputs, product prices, substitutability of other goods, weather, and existing technology.

Food and feed product producers compete with one another, with livestock producers, and with the export market for their primary agricultural product inputs. An abundant harvest can yield adequate supplies and good prices for the food and feed producer. To a certain extent, weather can influence product supply and input price.

Some of the commodities in Group IX are readily substitutable for other goods. Sugar can be substituted by corn syrup in many candy and bakery product uses and has lost a substantial share of its soft drink market to corn syrup.[1] In many food applications, vegetable oils are substitutable, and soybean oil can be replaced by cottonseed, coconut or palm oil as supply and price make these latter oils more competitive.

Technology can provide Group IX producers with better recovery ratios on crushing or milling operations and allow the producers to minimize production costs and maximize returns.

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1. Coca-Cola Company recently decided to start using fructose from corn as a substitute for up to half the sugar in Coke. This is viewed by the company as a cost-cutting move rather than a taste consideration. Wall Street Journal, March 6, 1980, p. 18.

C. Existing Production Levels

The production of food and feed products as a group increased in the PSAs at an average rate of less than 0.72 percent per annum in the 1969-76 period. In 1976, total PSA production stood at 3.2 million tons (Table 8). Of this 3.2 million tons, 2.36 million, or almost 75 percent of Group IX production, was represented by soybean processing by-products (i.e., soybean meal and oil). Wheat flour and wheat mill feed production represented 20 percent of 1976's Group IX production, and corn animal feed and corn oil represented about 6 percent. Neither sugar nor molasses was or is expected to be produced in the PSAs.

BEAs 47 (Huntsville) and 48 (Chattanooga) are the largest PSA food and feed product producers, each accounting for over 30 percent of total production (Table 8). Corn, wheat, and soybean processors are located in each of these BEAs. These two BEAs are expected to remain important producers in the future, with BEA 47 (Huntsville) exhibiting fast growth between 1974-76 and 1980 as a soybean processor increases its crushing capacity by 50 percent.

D. Forecasting Procedures and Assumptions

Projections of the production of food and feed products were based on existing projections. The primary source used was the U.S. Water Resources Council (OBERS, Series E). The 1974-76 three-year average of actual production of food and feed products was projected for 1980-2040 using the growth rate of earnings in the food and kindred products industry. The projected growth rates for the production of food and feed products in each BEA segment are assumed to be the same as those of the BEA as a whole. Known expansions by food and feed product producers are also taken into account.

E. Probable Future Production Levels

The total production of food and feed products in the PSAs in the year 2000 is expected to be more than double the production average of 1974-76. Production will continue to increase between 2000 and 2040, but at a reduced rate. BEAs 47 (Huntsville) and 48 (Chattanooga) have accounted, and will continue to account, for a major share of PSA production (Table 9).

A steady increase in total food and feed products production is expected in the PSAs, amounting to 2.6 percent per annum between 1976 and 2000 and 1.3 percent per annum between 2000 and 2040

Table 8. Ohio River Basin: Production of Food and Feed Products, by BEAs or BEA Segments,[a] Estimated 1969-76

(Thousands of tons unless otherwise specified)

BEA and BEA segment	1969	1970	1971	1972	1973	1974	1975	1976	Average annual percentage change 1969-76
Primary Study Areas	3,051.8	3,087.5	3,117.0	3,125.0	3,149.6	3,175.3	3,170.8	3,208.6	0.72
BEA 47: Huntsville, AL	1,042.4	1,054.9	1,065.1	1,065.9	1,076.0	1,086.8	1,085.2	1,098.4	0.75
BEA 48: Chattanooga, TN	1,039.8	1,051.8	1,062.5	1,066.4	1,073.0	1,080.3	1,078.9	1,091.6	0.70
BEA 49: Nashville, TN	143.1	144.7	145.7	146.6	147.6	148.2	148.0	149.7	0.65
BEA 50: Knoxville, TN	40.5	40.9	41.1	41.5	41.7	41.7	41.7	42.1	0.56
BEA 54: Louisville, KY	340.0	344.1	347.5	347.5	351.0	354.8	354.3	358.6	0.76
BEA 55: Evansville, IN	440.2	445.2	449.2	450.9	454.2	457.3	456.7	462.1	0.70
BEA 62: Cincinnati, OH	5.9	5.9	6.0	6.0	6.1	6.1	6.1	6.1	0.48
BEA 66: Pittsburgh, PA	--	--	--	--	--	--	--	--	--

Note: Individual items may not add to total due to rounding. Production of food and feed products was derived for 1976 by multiplying corn, wheat and soybean processing capacity by BEA and BEA segment obtained from Grains (Group V) Report by that percentage share of the processing's end-products which are classified as food and feed products. Percentage shares applied to wheat, soybean and wet processed corn capacities were provided by industry experts. The percentage of dry processed corn that yields food and feed products was derived from the Census of Manufactures, SIC Commodity Code 20413, Corn Mill Products. Wheat processing capacity was multiplied by .67 to derive wheat flour production and by .33 to derive wheat mill feed production. Soybean processing capacity was multiplied by .67 to derive soybean meal production and by .33 to derive soybean oil production. Dry-milled corn processing capacity was multiplied by .4178 to derive corn mill feed production and by .0868 to derive corn oil production. Wet-processed corn capacity was multiplied by .23143 to derive corn mill feed production. No sugar is produced in the study area. Wheat and corn mill feed production and soybean meal production were multiplied by 1.3 to add an additional 30% to the production weight represented by additional commodites (fish protein, phosphates, dried milk, etc.) added in the preparation of prepared animal feeds. Corn, wheat and soybean processors were assumed to be operating at full capacity in 1976. Food and feed product production for the years 1969-75 was derived by applying the growth rates of corn, wheat, and soybean disappearance for food and feed use on a national level to the BEA segment 1976 production, working the trend in reverse.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Processing capacity by BEA and BEA segment for 1976 from Grains (Group V) Report. Food and feed use national level growth rates derived from U.S. Department of Agriculture, Agricultural Statistics, 1977 ed. Corn yields from U.S. Department of Commerce, Bureau of the Census, Census of Manufactures, 1972 ed.

(Table 9). Food and feed production in the PSA in 1980 is expected to increase by almost 60 percent over 1976 production, to 4.25 million tons. Group IX production is expected to be 6.08 million tons in 2000 and 10.04 million tons in 2040.

Table 9. Ohio River Basin: Production of Food and Feed Products, by BEAs or BEA Segments,[a] Estimated Average 1974-76 and Projected 1980-2040, Selected Years

(Thousands of tons unless otherwise specified)

BEA and BEA segment	Estimated average 1974-76	Projected					Average annual percentage change	
		1980	1990	2000	2020	2040	1974-76—2000	2000-2040
Primary Study Areas	3,184.9	4,252.6	5,099.0	6,082.0	8,462.0	10,035.0	2.62	1.26
BEA 47: Huntsville, AL	1,090.2	1,877.1	2,221.1	2,622.5	3,645.3	4,348.7	3.57	1.27
BEA 48: Chattanooga, TN	1,083.6	1,245.3	1,540.4	1,859.5	2,589.7	3,055.2	2.18	1.25
BEA 49: Nashville, TN	148.6	168.3	214.0	265.8	385.0	464.2	2.35	1.40
BEA 50: Knoxville, TN	41.8	47.3	58.1	70.9	101.7	122.0	2.14	1.37
BEA 54: Louisville, KY	355.9	397.8	465.3	552.9	764.0	899.6	1.78	1.22
BEA 55: Evansville, IN	458.7	509.9	591.8	700.4	962.1	1,128.4	1.71	1.20
BEA 62: Cincinnati, OH	6.1	6.9	8.3	10.0	14.2	16.9	2.00	1.32
BEA 66: Pittsburgh, PA	--	--	--	--	--	--	--	--

Note: Individual items may not add to total due to rounding. The 1974-76 three year average of actual production of food and feed products was projected for 1980-2040 using the growth rate of earnings in the food and kindred products industry as projected by U.S. Department of Commerce, OBERS Projections.

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: Production of food and feed products by BEA segment for 1974-76 from Table 8. Average annual growth rates were derived from U.S. Water Resources Council, 1972 OBERS Projections, Regional Economic Activity in the U.S., Vol. II.

IV. TRANSPORTATION CHARACTERISTICS

In the United States, food and feed products are generally transported by truck and, to a lesser degree, by rail. Waterway movements are not common. While this pattern of transport also applies to the area served by the ORS, the convenience of rivers flowing through producing and consuming areas provides some notable exceptions.

A. Existing and Historical Modal Split

Transportation of food and feed products within the PSAs is dominated by truck movements. In 1976, the area served by the ORS was a net receiver of food and feed products by all modes. Of the 1.65 million tons of Group IX products received in the PSAs in 1976, net rail receipts accounted for 751 thousand tons and net truck receipts for 1.22 million tons (Table 10). There was, however, a net movement of 312.2 thousand tons of Group IX products by water in 1976. In general, the ORS hinterland ships out flour and soybean meal and oil, while importing molasses and sugar via the inland waterway system.

Waterborne movements of food and feed products are relatively important in those BEAs where production and/or consumption takes place near the waterway. In 1976, BEAs 47 (Huntsville), 48 (Chattanooga) and 55 (Evansville) generated the majority of outbound waterborne movements. They are locations of waterside Group IX product producers. BEAs 47 (Huntsville) and 62 (Cincinnati) generated the majority of inbound waterborne movements and are locations of food processors located near the water.

B. Intermodal Characteristics

The relative shares of net movements of truck, rail and water are presented in Table 10. As in the case of other commodities,

Table 10. Ohio River Basin: Production, Consumption and Shipments by Mode of Transportation of Feed and Food Products, by BEAs or BEA Segments,[a] Estimated 1976

(Thousands of tons)

BEA and BEA segment	Production	Consumption	Shipments (receipts)						
				Water					
			Total net	Net	Inbound	Outbound	Local	Net rail	Net truck
Primary Study Areas	3,208.6	4,864.3	(1,655.7)	312.2	458.7[b]	770.9[b]	37.8[b]	(750.6)	(1,217.3)
BEA 47: Huntsville, AL	1,098.4	447.8	650.6	156.7	155.2	311.9	1.1	64.4	429.5
BEA 48: Chattanooga, TN	1,091.6	505.3	586.3	116.5	29.3	145.8	--	(66.3)	536.1
BEA 49: Nashville, TN	149.7	953.2	(803.5)	(11.1)	15.6	4.5	--	(164.1)	(628.3)
BEA 50: Knoxville, TN	42.1	350.5	(308.4)	(6.7)	6.7	--	--	(105.6)	(196.1)
BEA 54: Louisville, KY	358.6	730.5	(371.9)	(15.7)	15.7	--	--	(109.6)	(246.6)
BEA 55: Evansville, IN	462.1	667.7	(205.6)	235.4	22.3	257.7	--	76.6	(517.6)
BEA 62: Cincinnati, OH	6.1	741.8	(735.7)	(113.9)	197.1	83.2	--	(226.9)	(394.9)
BEA 66: Pittsburgh, PA	--	467.5	(467.5)	(49.0)	53.5	4.5	--	(219.1)	(199.4)

Note: Gross and net waterborne and rail shipments (receipts) were determined for 1976 from U.S. Army Corps of Engineers waterborne commerce data and Interstate Commerce Commission railroad waybill data. Total net shipments (receipts) were determined by subtracting consumption from production. Net truck shipments (receipts) were determined by subtracting net waterborne and rail shipments (receipts) from total net shipments (receipts).

a. BEA segments defined as counties which are ultimate origins or destinations of waterborne movements.

b. Primary Study Area shipments equal inbound, outbound and local shipments for the PSAs as a unit and do not equal the sum of shipments reported for each of the BEA segments.

Source: Production and consumption from Tables 6 and 8. Water shipments from Waterborne Commerce by Port Equivalents, revised 1976, supplied by the U.S. Army Corps of Engineers. Rail shipments from ICC Railroad Waybill Sample, 1976, supplied by the U.S. Army Corps of Engineers.

the choice of mode for the transportation of food and feed products is influenced by the transport rates and time implicit in the location of consumption and production areas. Inherent in any modal choice is an appropriate origin and destination pair, as well as the existence of the necessary facilities and equipment, such as tank cars for moving vegetable oils.

The choice of a food and feed product transport mode is largely governed by the location of the consumption market relative to the producing sources. Much of the domestic market is served by truck. The quick and regular service is a significant user-supplier factor in the highly competitive market of relatively uniform products, such as flour. On the other hand, barge transport has an absolute advantage over other modes when production and consumption areas are located in the proximity of a river which provides a relatively direct route between two areas. This is certainly true for the import of sugar and molasses originating in the Gulf of Mexico and destined to waterside food processors. It is also true as in the case of export-bound soyameal and soybean oil originating from waterside ORB food and feed product producers.

With the expected waterside expansion in food and feed product production in the PSAs and as long as food processors do not relocate, barge transportation of Group IX products is expected to grow in the future.

C. Forecasting Procedures and Assumptions

Generally, the projections of food and feed product movement in the PSAs assume that future origin and destination links and future modal split will conform to the links and modal split in 1976. The assumption underlying this procedure is that 1976 flows will be representative of future flows to a large degree.

Initial projections of waterborne commerce were developed using preliminary information provided by the Corps of Engineers. These initial projections were derived according to the procedures described below.

For both water and rail movements, the relationship between inbound shipments and consumption and between outbound shipments and production were held constant. However, the relationship between gross inbound waterborne receipts and net shipments was chosen when a PSA was a net producer but had waterborne receipts. The gross outbound shipment relationship to net shipments was chosen when a PSA was a net consumer but had waterborne shipments.

The choice of this alternative relationship was chosen in the specific case of future waterborne movements of BEA 66 (Pittsburgh). Deviations from the 1976 pattern were projected only where specific changes are anticipated.

Based on the assumptions that there will be no change in relative prices of transportation modes and that relative transport time will not change significantly, it is expected that the future modal split will not vary significantly from the 1976 splits for each PSA.

Truck movements were projected by assuming that net truck was equal to total net shipments less net water and net rail shipments.

Waterway flows from SPAs to areas within the ORB were related to the future consumption of each PSA within the ORB. Flows to SCAs from areas within the ORB were related to the future production of each PSA in the ORB. These relationships were based on historical relationships. Through this procedure, the change in waterborne movements for the Ohio River Basin as a whole is captured by the different growth rates of production and consumption of each PSA in the ORB.

As more complete information was made available by the Corps of Engineers, the initial projections of BEA-to-BEA waterborne traffic were adjusted.[1]

D. Probable Future Modal Split

A summary of the probable future modal split of food and feed product shipments in the area served by the ORS for all projection years, and the actual modal split for 1976 base year, is presented in Table 11.

The modal split of each PSA in the ORB is not expected to shift dramatically. In general, those BEAs or BEA segments that have historically been either large outbound or inbound waterway shippers or receivers [i.e., BEAs 47 (Huntsville), 48 (Chattanooga) and 55 (Evansville) and BEAs 47 and 62 (Cincinnati)] are expected to maintain their relative importance. The same is true for rail shippers and/or receivers. The proportional relationship of net rail to net water shipments is expected to remain relatively stable, with net rail shipments being somewhat less than twice the volume of net water shipments.

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1. A description of the manner in which the initial projections were adjusted is contained in the Methodology Report.

E. Probable Future Waterway Flows

BEA-to-BEA waterborne traffic projections are presented in Table 12. Growth indices derived from the traffic projections are presented in Table 13.

The average annual growth rate of net waterborne food and feed product shipments is projected to be 4.5 percent between 1976 and 2000 and 1.4 percent between 2000 and 2040 (Table 11). These rates occur because of the low growth of inbound shipments relative to outbound shipments.

Outbound waterborne shipments are expected to increase at a rate of 2.7 percent per annum between 1976 and 2000. Inbound movements are expected to increase only slightly between 1976 and 2000, as some portion of ORB demand for waterborne Group IX shipments is expected to be satisfied by local production. Local movements are expected to remain relatively small. They are projected to grow at an annual rate of 2.5 percent between 1976 and 2000 and at a rate of 1.0 percent between 2000 and 2040.

The total (gross) waterborne shipments will reach 3.40 million tons in 2040 as compared to 1.27 million tons in 1976. Waterborne food and feed products are expected to continue to be relatively insignificant in the Ohio River System in the future.

Table 11. Ohio River Basin: Production, Consumption and Shipments by Mode of Transportation of Feed and Food Products, Nec. Estimated 1976 and Projected 1980-2040, Selected Years

(Thousands of tons unless otherwise specified)

	Estimated 1976	Projected 1980	1990	2000	2020	2040	Average annual percentage change 1976-2000	2000-2040
Production	3,208.6	4,252.6	5,099.0	6,082.0	8,462.0	10,035.0	2.7	1.3
Consumption	4,864.3	5,218.0	6,075.6	7,155.5	9,420.7	10,930.6	1.6	1.1
Net shipments (receipts)	(1,655.7)	(965.4)	(976.6)	(1,073.5)	(958.7)	(895.6)	(1.8)	(0.5)
Net waterborne	312.2	550.1	778.3	900.5	1,311.4	1,566.2	4.5	1.4
Net rail	(750.7)	(729.5)	(779.6)	(862.4)	(935.5)	(990.5)	0.6	0.4
Net truck	(1,217.2)	(786.0)	(975.3)	(1,111.6)	(1,334.6)	(1,471.3)	(0.4)	0.7
Gross waterborne shipments:								
Outbound	770.9	1,045.5	1,242.9	1,444.3	2,051.2	2,432.3	2.7	1.3
Inbound	458.7	495.4	464.6	543.8	739.8	866.1	0.7	1.2
Local	37.8	44.0	51.4	67.8	84.1	100.7	2.5	1.0
Total	1,267.4	1,584.9	1,758.9	2,055.9	2,875.1	3,399.1	2.0	1.3

Note: Projected net shipments (receipts) determined by subtracting projected consumption from projected production. Initial waterborne shipments and receipts projected on the basis of preliminary information provided by the Corps of Engineers. Waterborne and rail receipts by BEA and BEA segment were assumed to increase at the same rate as consumption by BEA and BEA segment. Waterborne and rail shipments by BEA and BEA segment were assumed to increase at the same rate as production by BEA and BEA segment. As more complete information regarding 1976 waterborne traffic was made available, BEA-to-BEA traffic projections were revised, and projected to increase/decrease at the same rates as the initial projections using actual 1976 tonnages as the base. Net truck equal to total net shipments less net water and rail shipments.

Source: Tables 7, 9 and 10; Waterborne Commerce by Port Equivalents, revised 1976, and ICC Railroad Waybill Sample, 1976, supplied by the U.S. Army Corps of Engineers.

Table 12. Ohio River System: BEA-to-BEA Waterborne Traffic of Feed and Food Products, Nec., Actual 1976 and Projected 1980-2040, Selected Years

ORIGIN BEA	DESTINATION BEA	COMMODITY GROUP	HUNDREDS OF TONS					
			1976	1980	1990	2000	2020	2040
047	046	09	145	247	293	346	481	574
047	047	09	11	24	33	51	81	103
047	054	09	22	36	39	49	54	61
047	079	09	11	19	22	26	36	43
047	138	09	2941	5023	5950	7011	9761	11643
048	138	09	1458	1664	2057	2483	3458	4081
049	141	09	45	50	64	80	116	139
055	062	09	345	380	442	578	706	843
055	138	09	2232	2464	2857	3073	4647	5451
062	138	09	832	940	1132	1364	1937	2305
066	138	09	45	48	54	60	76	87
077	047	09	166	181	222	249	364	447
077	048	09	41	46	57	68	91	99
078	048	09	11	12	14	16	23	26
079	055	09	45	38	43	47	55	63
079	062	09	40	42	23	28	36	43
091	047	09	156	172	209	224	353	418
091	048	09	73	82	100	120	157	172
091	062	09	60	63	38	42	53	64
103	047	09	434	477	589	674	993	1187
108	047	09	134	148	182	209	306	367
111	055	09	11	9	11	11	15	17
111	062	09	67	74	41	59	63	77
111	066	09	45	48	55	62	78	88
113	062	09	272	296	172	179	270	308
114	062	09	469	508	294	318	453	539
114	066	09	412	446	488	550	692	781
133	048	09	11	12	14	16	23	26
137	047	09	20	23	27	31	45	55
138	047	09	642	700	867	1059	1459	1731
138	048	09	157	173	206	242	317	385
138	049	09	156	172	205	245	323	374
138	050	09	67	74	88	107	148	176
138	054	09	135	137	157	180	243	283
138	055	09	167	157	173	203	246	275
138	062	09	718	780	279	396	454	503
138	066	09	78	84	92	103	138	157
		TOTAL	12674	15849	17589	20559	28751	33991

Source: Robert R. Nathan Associates, Inc.

Table 13. Ohio River System: Growth Rates
Feed and Food Products, Nec., Waterborne Commerce,
BEA to BEA,
Projected 1976-2040,
Selected Years

BEA Pair[a]	Group No.	Index Value[b]	Year[c] 1976	1980	1990	2000	2020	2040
047047	09	11	1000	2167	3000	4667	7333	9333
047054	09	22	1000	1643	1786	2214	2464	2786
047079	09	11	1000	1692	2000	2385	3308	3923
047138	09	2941	1000	1708	2023	2384	3319	3959
047046	09	145	1000	1705	2023	2386	3318	3962
048138	09	1458	1000	1141	1411	1703	2372	2799
049141	09	45	1000	1119	1429	1786	2571	3095
055062	09	345	1000	1102	1282	1675	2046	2443
055138	09	2232	1000	1104	1280	1377	2082	2442
062138	09	832	1000	1130	4500	5000	6500	7200
066138	09	45	1000	1071	1190	1333	1690	1929
077047	09	166	1000	1091	1335	1500	2193	2693
077048	09	41	1000	1119	1381	1667	2214	2405
078048	09	11	1000	1077	1308	1462	2077	2385
079055	09	45	1000	846	949	1051	1231	1410
079062	09	40	1000	1051	564	692	897	1077
091047	09	156	1000	1100	1338	1438	2263	2681
091048	09	73	1000	1125	1375	1639	2153	2361
091062	09	60	1000	1056	630	704	889	1074
103047	09	434	1000	1098	1357	1553	2287	2736
108047	09	134	1000	1103	1357	1556	2286	2738
111055	09	11	1000	833	1000	1000	1333	1500
111062	09	67	1000	1098	607	885	934	1148
111066	09	45	1000	1071	1214	1381	1738	1952
113062	09	272	1000	1090	631	659	993	1133
114062	09	469	1000	1084	627	678	965	1149
114066	09	412	1000	1083	1185	1336	1680	1895
133048	09	11	1000	1077	1308	1462	2077	2385
137047	09	20	1000	1133	1333	1533	2267	2733
138047	09	642	1000	1090	1351	1649	2272	2697
138048	09	157	1000	1099	1309	1539	2020	2454
138049	09	156	1000	1105	1315	1571	2068	2398
138050	09	67	1000	1106	1318	1591	2212	2621
138054	09	135	1000	1016	1165	1330	1802	2093
138055	09	167	1000	942	1036	1216	1475	1647
138062	09	718	1000	1087	389	552	632	701
138066	09	78	1000	1079	1180	1326	1754	2011

a. The first three digits indicate the BEA of origin, the last three digits indicate BEA of destination.

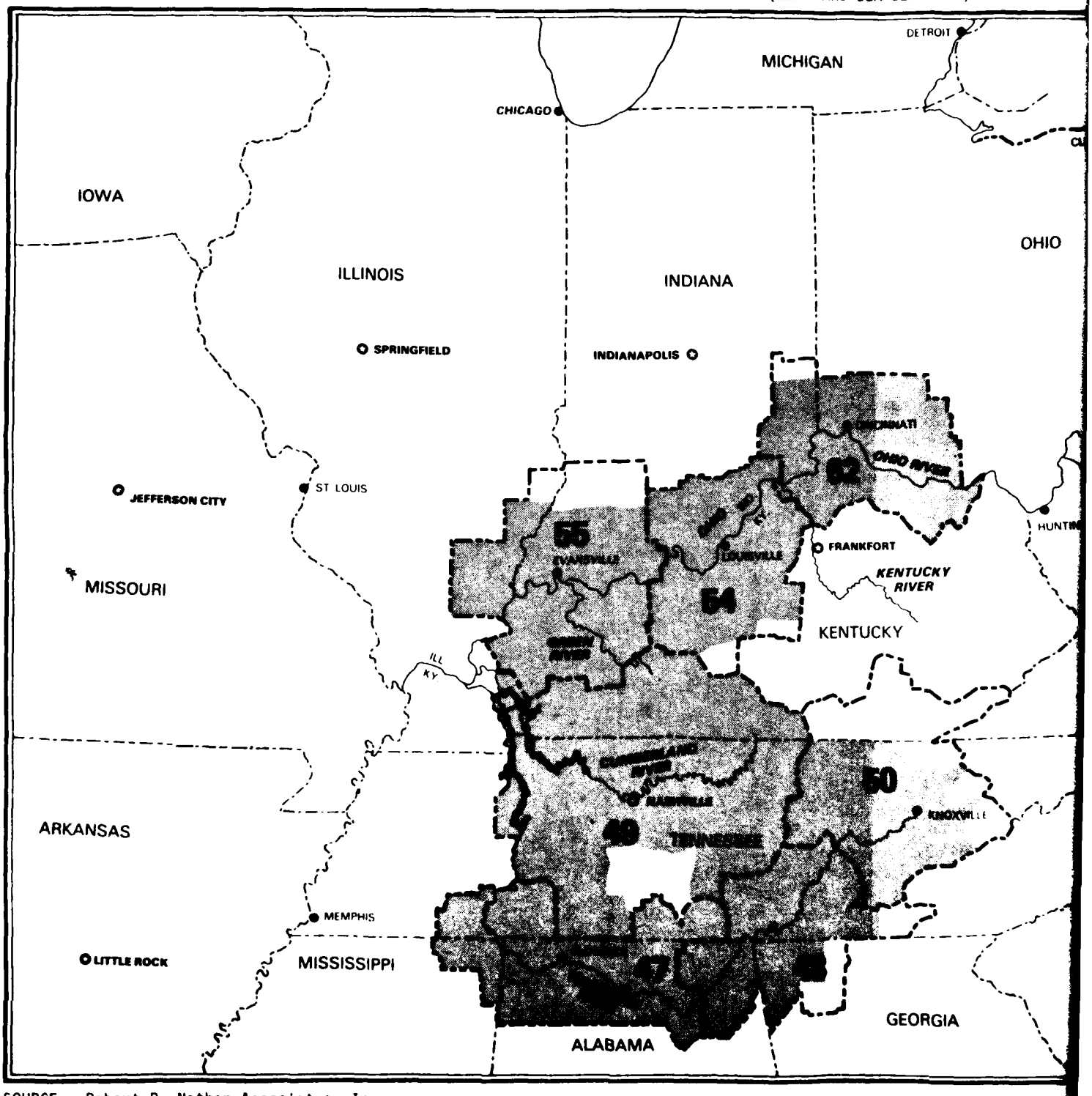
b. Hundreds of tons.

c. Growth rates are reported such that 1000 equals the index value reported in the third column.

Source: Robert R. Nathan Associates, Inc.

V. APPENDIX

MAP A-1. OHIO RIVER BASIN: PRIMARY STUDY AREAS FOR FEED AND FO
(BEAs AND BEA SEGMENTS)



SOURCE: Robert R. Nathan Associates, Inc.

-1. OHIO RIVER BASIN: PRIMARY STUDY AREAS FOR FEED AND FOOD PRODUCTS, NEC.
(BEAs AND BEA SEGMENTS)

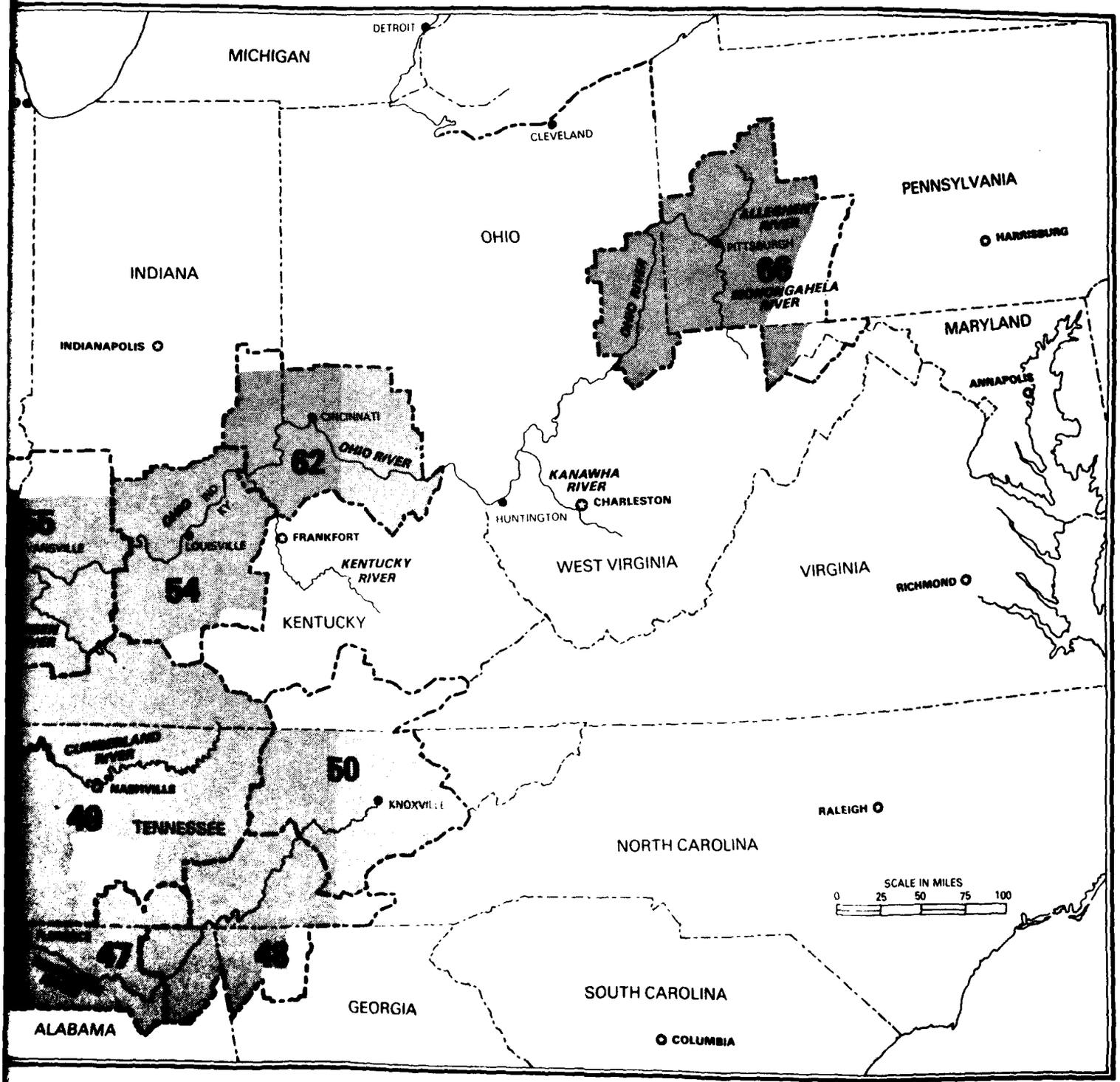


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Table A-1. Ohio River Basin: Primary Study Areas for Feed and Food Products, Nec.

(BEAs and BEA segments)

BEA 47: Huntsville, AL
Colbert, AL
Franklin, AL
Lauderdale, AL
Lawrence, AL
Limestone, AL
Madison, AL
Marshall, AL
Morgan, AL
Alcorn, MS
Tishomingo, MS
Franklin, TN
Hardin, TN
Lincoln, TN
McNairy, TN
Wayne, TN

BEA 48 (segment): Chattanooga, TN
DeKalb, AL
Jackson, AL
Catoosa, GA
Chattooga, GA
Dade, GA
Walker, GA
Whitfield, GA
Bledsoe, TN
Bradley, TN
Grundy, TN
Hamilton, TN
Marion, TN
McMinn, TN
Meigs, TN
Polk, TN
Rhea, TN
Sequatchie, TN

BEA 49 (segment): Nashville, TN
Allen, KY
Barren, KY
Butler, KY
Christian, KY
Clinton, KY
Cumberland, KY
Edmonson, KY
Logan, KY
Metcalfe, KY
Monroe, KY
Simpson, KY
Todd, KY
Trigg, KY
Warren, KY
Benton, TN
Cannon, TN
Cheatham, TN
Clay, TN
Coffee, TN
Davidson, TN
DeKalb, TN
Dickson, TN
Giles, TN
Hickman, TN
Houston, TN
Humphreys, TN
Jackson, TN
Lawrence, TN
Lewis, TN
Macon, TN
Maury, TN
Montgomery, TN
Overton, TN
Perry, TN
Pickett, TN
Putnam, TN
Robertson, TN
Rutherford, TN
Smith, TN
Stewart, TN
Trousdale, TN
Van Buren, TN
Warren, TN
White, TN
Wilkiamson, TN
Wilson, TN

BEA 50 (segment): Knoxville, TN
Anderson, TN
Blount, TN
Campbell, TN
Cumberland, TN
Fentress, TN
Grainger, TN
Jefferson, TN
Knox, TN
Loudon, TN
Monroe, TN
Morgan, TN
Roane, TN
Scott, TN
Sevier, TN
Union, TN

BEA 54 (segment): Louisville, KY
Clark, IN
Crawford, IN
Floyd, IN
Harrison, IN
Jefferson, IN
Orange, IN
Scott, IN
Washington, IN
Breckenridge, KY
Bullitt, KY
Grayson, KY
Hardin, KY
Henry, KY
Jefferson, KY
Meade, KY
Nelson, KY
Oldham, KY
Shelby, KY
Trimble, KY
Washington, KY

BEA 55 (segment): Evansville, IN
Caldwell, KY
Crittenden, KY
Daviess, KY
Hancock, KY
Henderson, KY
Hopkins, KY
McLean, KY
Muhlenberg, KY
Ohio, KY
Union, KY
Webster, KY
Edwards, IL
Gallatin, IL
Hamilton, IL
Saline, IL
Wabash, IL
White, IL
Dubois, IN
Gibson, IN
Perry, IN
Pike, IN
Posey, IN
Spencer, IN
Vanderburgh, IN

BEA 62 (segment): Cincinnati, OH
Dearborn, IN
Franklin, IN
Ohio, IN
Ripley, IN
Switzerland, IN
Boone, KY
Bracken, KY
Campbell, KY
Carroll, KY
Fleming, KY
Gallatin, KY
Grant, KY
Kenton, KY
Lewis, KY
Mason, KY
Owen, KY
Pendleton, KY
Robertson, KY
Adams, OH
Butler, OH
Brown, OH
Clermont, OH
Clinton, OH
Hamilton, OH
Highland, OH
Warren, OH

BEA 66 (segment): Pittsburgh, PA
Garrett, MD
Belmont, OH
Harrison, OH
Jefferson, OH
Monroe, OH
Allegheny, PA
Armstrong, PA
Beaver, PA
Butler, PA
Clarion, PA
Fayette, PA
Greene, PA
Indiana, PA
Washington, PA
Westmoreland, PA
Brooke, WV
Hancock, WV
Marshall, WV
Ohio, WV
Tyler, WV
Wetzel, WV

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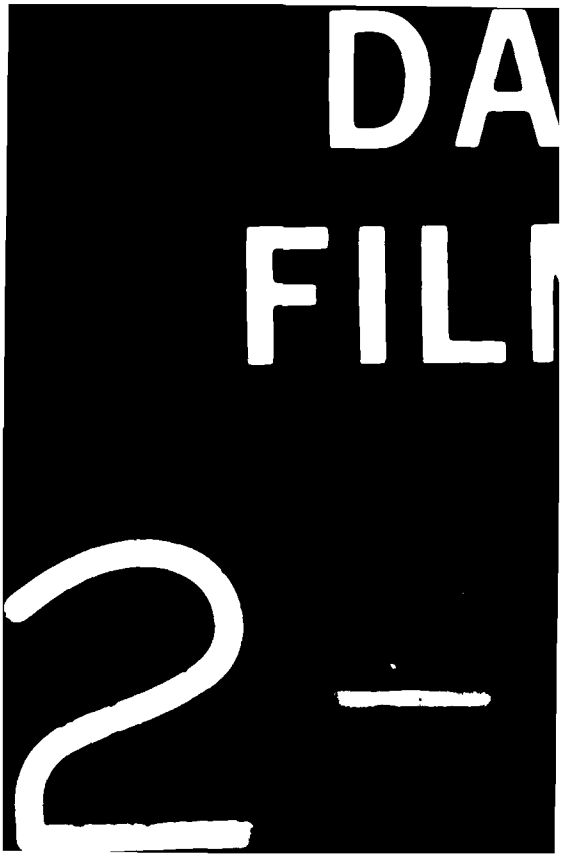
B. Associations, Government Agencies, Educational Institutions

National Grain and Feed Association
U.S. Department of Agriculture, Crop Reporting Service
U.S. Department of Agriculture, Economics, Statistics, and Cooperatives Service

C. Industrial Shippers and Receivers

ADM Milling, Mt. Vernon, Indiana
American Maize Products, Decatur, Alabama
Continental Grain, Guntersville, Alabama
Dixie Portland Flour Mill, Chattanooga, Tennessee
Owensboro Grain Terminal, Owensboro, Kentucky
Ralston Purina, Louisville, Kentucky
Seaboard Allied Milling Company, Chattanooga, Tennessee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